CLAIM + DETAILED DESCRIPTION

[Claim(s)]
[Claim 1]In a laser device which has an optical-intensity-modulation means by an acoustooptic modulation element, An optic axis of an optical element which has negative power behind said acoustooptic modulation element is arranged on a desired beam optic axis and the same axle of a modulated beam to which it is emitted from said acoustooptic modulation element, A separation angle of several diffraction beams which are emitted from said acoustooptic modulation element and from which an outgoing radiation angle differs mutually is expanded, A laser optics device arranging a shielding member which has an opening of a size which does not let through and the other unnecessary diffraction beam pass only for a modulated beam of said request so that the center of said opening may be in agreement with said optic axis, and shading said unnecessary diffraction beam.
[Claim 2]In a laser device which has an optical-intensity-modulation means by an acoustooptic modulation element, An optic axis of an optical element which has positive power behind said acoustooptic modulation element is arranged on a desired beam optic axis and the same axle of a modulated beam to which it is emitted from said acoustooptic modulation element, [a beam optic axis of several unnecessary diffraction beams from which an outgoing radiation angle emitted from said acoustooptic modulation element differs] A separation angle is expanded by [which were made to once intersect an optic axis of said optical element by a convergent point behind / focal / said optical element] making it back-emit, [a position where it was equal to distance from said optical element to said convergent point, or only a larger distance than it separated from said convergent point] A laser optics device arranging a shielding member which has an opening of a size which does not let through and the other unnecessary diffraction beam pass only for a modulated beam of said request so that the center of said opening may be in agreement with said optic axis, and shading said unnecessary diffraction beam.
[Claim 3]In a laser device which has an optical-intensity-modulation means by an acoustooptic modulation element, [an optic axis of an afocal optical system which comprises a 2 group lens which has positive power behind said acoustooptic modulation element] Arrange on a desired beam optic axis and the same axle of a modulated beam which are emitted from said acoustooptic modulation element, and with a refraction operation of a front group of said afocal optical system, [a beam optic axis of several unnecessary diffraction beams from which an outgoing radiation angle emitted from said acoustooptic modulation element differs] A separation angle is expanded by making it once emit after converging behind [focal] said optical element, Just before a rear group of said afocal optical system, or in an immediately after position, only a modulated beam of said request Through, A laser optics device arranging a shielding member which has an opening of a size which does not let the other unnecessary diffraction beam pass so that the center of said opening may be in agreement with said optic axis, and shading said unnecessary diffraction beam.

[Claim 4]The laser optics device according to claim 3, wherein said afocal optical system is a beam expander whose rear group focal length is longer than a front group focal length.
[Claim 5]Several laser beams from which a wavelength differs are individually modulated with an acoustooptic modulation element corresponding, respectively, It has a beam synthesizing means which consists of two or more deflection devices which compound a beam optic axis of a modulated beam of each request on the same axle among two or more diffraction beams obtained, [a synthetic beam which was compounded by this beam synthesizing means and containing a different wavelength] It is arranged in the back, coincide said beam optic axis and an optic axis, and an afocal optical system constituted with an AKURO mart lens is entered, Have an opening of a size which does not let through and the other unnecessary diffraction beam pass only for said synthetic beam arranged just before a rear group of said afocal optical system, or to immediately after, and with a shielding member which is in agreement with said optic axis, [the center of this opening] A laser optics device taking out only a desired modulated beam as a parallel pencil.
[Claim 6][by making equivalent to a wavelength of an entering laser beam a carrier frequency of an ultrasonic wave inputted into said acoustooptic modulation element corresponding, respectively, and changing it] The laser optics device according to claim 5 which make a separation angle of two or more diffraction beams mutual almost equal, and a beam optic axis of a modulated beam of said request is compounded on the same axle by said beam synthesizing means, and is characterized by coinciding **** of said unnecessary diffraction beam mostly.
[Claim 7]The laser optics device according to claim 5 or 6 having arranged an AKURO mart condenser behind said afocal optical system.
[Claim 8]The laser optics device according to claim 5, 6, or 7, wherein a path of a beam with a longer wavelength among beams which enter into said afocal optical system is larger than a path of a beam with a shorter wavelength.
[Claim 9]A beam scanning device which is a beam scanning device which has a laser optics device of any one description of the Claims 1-8, and is back characterized by having one piece or two beam scanning means which scan a modulated beam of said request from said all optical systems.

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the laser device which can be used for a laser marker, a laser trimmer, a laser display, etc. using the acoustooptical device (it calls the following AOM) as a beam intensity modulation means, or the beam scanning device which added the beam scanner style to this device. The modulated beam of the request diffracted by AOM and the other unnecessary diffraction beam are separated clearly in detail, and it is related with the art which takes out only a desired modulated beam.
[0002]
[Description of the Prior Art]By modulating a laser beam by AOM, it is known that a laser device with various functions can be constituted. AOM can modulate the intensity

of an incident beam and is used for various laser devices, such as a laser marker, a laser trimmer, and a laser display. A modulation method is one of the intensity modulation methods of laser directly, and a modulation method is directly used in a low-power output semiconductor laser in many cases. However, if a laser output becomes high, in a modulation method, a duty ratio will fall directly. On the other hand, since AOM can secure a duty ratio even when laser beam power is large, it serves as an effective modulation means in the laser device using the high power laser of the watt class.
[0003]Although two, a zero order light and primary light, exist in the diffraction beam emitted from AOM, the primary [-] diffraction light [secondary / +] may be simultaneously emitted by the incidence conditions of a beam, etc. Among these, it is usually only the primary diffraction light which is used as an abnormal-conditions light. It will be called the modulated beam of a request of this. Since other beams are unnecessary, it will be called an unnecessary diffraction beam. The unnecessary diffraction beam needs to shade. However, the diffraction separation angle of the diffraction beam emitted from AOM is very as small as number milliradian. Therefore, it is difficult to shade only an unnecessary diffraction beam near the AOM, and if it is going to shade except a desired modulated beam with a gobo with an opening, a beam diameter and an opening diameter will become almost the same. Then, a beam will diffract with the edge of an opening. If the position of an opening shifts, a transmitted light amount will fall, and light use efficiency will fall.
[0004]An unnecessary diffraction beam is intercepted and the art indicated to JP,H9-5689,A is known as art which takes out only a desired modulated beam. This art leads two or more diffraction beams with few separation angles emitted from AOM to the beam expander which consists of a convex lens of two groups, and it places the gobo which the pinhole opened to the focal plane of the front group, and he is trying to pass only a desired modulated beam.
[0005]
[Problem to be solved by the invention]estrangement of two or more diffraction beams emitted from AOM in the position distant from AOM enough -- since distance spreads, shading of an unnecessary diffraction beam becomes easy, but since long light path length is required, a device will be enlarged. Although it is possible to turn up **** by a mirror and to miniaturize a device as an evasion measure, an equipment configuration becomes complicated and adjustment also becomes complicated. estrangement of two or more diffraction beams -- the method of arranging a wedge board is on outgoing radiation one end of AOM like drawing 10 as a method of the exception of the conventional technology which expands distance becoming. Two or more diffraction lights 1 and 2 which entered from the surface of the wedge board 3 penetrate predetermined substrate thickness, it reflects with the back of the wedge board 3, and they penetrate the inside of a substrate again, and emit it from the surface of the wedge board 3. After making two or more diffraction lights 1 and 2 which were close according to the above process estrange to some extent and estranging them, an unnecessary diffraction beam can be covered via the shielding member 4 which has the opening 4a. However, by this method, a non-**** difference occurs with a beam and the condensing characteristic deteriorates. Since it becomes a system by which **** of a beam is turned up, in performing trichromatic beam composition in the latter part of this system, arrangement adjustment of a system becomes complicated. Since it is necessary to install this system to each trichromatic

****, arrangement of a system becomes much more complicated. Although the optical system of a description has a small separation angle in said JP,H9-5689,A and there is an advantage which can also separate clearly two or more light flux which overlaps partially and is carried out with a gobo with the pinhole which lets only a desired beam pass, Since the condensing point of each light flux is considerably close, its permissible error given to the composition of a pinhole is not so large. Ideally, by a larger opening than the diameter of a modulated beam, an unnecessary diffraction beam can be shaded and not to need long optical distance moreover is desired.

[0006]As for a modulated beam, in a laser device, it is desirable to be spread in the state parallel or near in parallel. If a beam emits, enlargement of a back optical system is needed and will carry out a cost rise. Although it is known that the parallelism of the direction which enlarged the diameter of a beam of a propagation beam will improve from the Gaussian propagation characteristic principle of a laser beam, In the use of a laser marker, a laser trimmer, a laser scan display, etc., the depth of focus at the time of condensing at the end, once it extends the diameter of a beam becomes shallow, and if depth is shallow, the accuracy of position of a processing side or a screen will become severe. The cases where the optical system which enlarges the diameter of a beam and improves the parallelism of a propagation beam from the above thing is adopted are rare. It is desirable to maintain the state near [as possible] the diameter of a beam emitted from laser in short, and to make a beam spread.

[0007]In the device which modulates and uses each of the laser of a different wavelength, AOM corresponding to each of the laser beam from which a wavelength differs has the same problem. If each of the beam from which a wavelength differs passes AOM, a diffraction beam number will increase, but the method of shading a diffraction beam unnecessary [among these] simultaneously efficiently is desired. Although the modulated beam of the request with the selected shading means differs in the wavelength, these beams can be condensed or it can consider the device made to scan. In this case, an equipment configuration which can coincide the condensing position and spot size of the beam from which a wavelength differs is desired.

[0008]Based on these problems, it sets it as the main purpose to shade the unnecessary diffraction beam emitted from AOM within a short optical course by this invention. And it sets it as the main purpose to enable control of the parallelism of a desired modulated beam. It aims at the following. The diffraction light separation effect is made high and the processing accuracy of parts and the adjustment accuracy of attachment are eased. In the laser device which uses simultaneously the laser from which a wavelength differs, all the unnecessary diffraction beams are shaded simultaneously and a desired modulated beam is changed into a collimated beam. The same focal position is made to condense the modulated beam from which a wavelength differs. While scanning the beam from which the wavelength modulated by AOM differs and making the same position condense, condensing spot size is also made the same. And it aims at providing the beam scanning device using these laser optics device.

[0009]

[Means for solving problem]In order to solve said technical problem, [the invention of an application concerned according to claim 1] In the laser device which has an optical-intensity-modulation means by an acoustooptic modulation element (it calls the following AOM), The optic axis of the optical element which has negative power behind said AOM

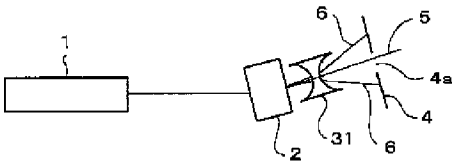
is arranged on the desired beam optic axis and same axle of a modulated beam to which it is emitted from said AOM, The separation angle of several diffraction beams which are emitted from said AOM and from which an outgoing radiation angle differs mutually is expanded, The shielding member which has an opening of the size which does not let through and the other unnecessary diffraction beam pass only for the modulated beam of said request is arranged so that the center of said opening may be in agreement with said optic axis, and said unnecessary diffraction beam is shaded.
[0010]In the laser device which has an optical-intensity-modulation means by AOM in the invention according to claim 2, The optic axis of the optical element which has positive power behind said AOM is arranged on the desired beam optic axis and same axle of a modulated beam to which it is emitted from said AOM, [the beam optic axis of several unnecessary diffraction beams from which the outgoing radiation angle emitted from said AOM differs] A separation angle is expanded by [which were made to once intersect the optic axis of said optical element by the convergent point behind / focal / said optical element] making it back-emit, [the position where it was equal to the distance from said optical element to said convergent point, or only a larger distance than it separated from said convergent point] The shielding member which has an opening of the size which does not let through and the other unnecessary diffraction beam pass only for the modulated beam of said request is arranged so that the center of said opening may be in agreement with said optic axis, and said unnecessary diffraction beam is shaded.
[0011]In the laser device which has an optical-intensity-modulation means by AOM in the invention according to claim 3, Arrange the optic axis of the afocal optical system which comprises a 2 group lens which has positive power behind said AOM on the desired beam optic axis and same axle of a modulated beam to which it is emitted from said AOM, and with a refraction operation of the front group of said afocal optical system, [the beam optic axis of several unnecessary diffraction beams from which the outgoing radiation angle emitted from said AOM differs] A separation angle is expanded by making it once emit after converging behind [focal] said optical element, Just before the rear group of said afocal optical system, or in an immediately after position, the shielding member which has an opening of the size which does not let through and the other unnecessary diffraction beam pass only for the modulated beam of said request is arranged so that the center of said opening may be in agreement with said optic axis, and said unnecessary diffraction beam is shaded in it.
[0012]In the invention according to claim 4, in the laser optics device according to claim 3, [said afocal optical system] [that it is a beam expander whose rear group focal length is longer than a front group focal length] [the invention according to claim 5 by which it is characterized] Several laser beams from which a wavelength differs are individually modulated by AOM corresponding, respectively, It has a beam synthesizing means which consists of two or more deflection devices which compound the beam optic axis of the modulated beam of each request on the same axle among two or more diffraction beams obtained, [the synthetic beam which was compounded by this beam synthesizing means and containing a different wavelength] It is arranged in the back, coincide said beam optic axis and an optic axis, and the afocal optical system constituted with the AKURO mart lens is entered, Have an opening of the size which does not let through and the other unnecessary diffraction beam pass only for said synthetic beam arranged just before the rear group of said afocal optical system, or to immediately after, and with the shielding

member which is in agreement with said optic axis, [the center of this opening] Only a desired modulated beam is taken out as a parallel pencil.
[0013]In the laser optics device according to claim 5 by the invention according to claim 6, [by making equivalent to the wavelength of the entering laser beam the carrier frequency of the ultrasonic wave inputted into said AOM corresponding, respectively, and changing it] Make the separation angle of two or more diffraction beams mutual almost equal, and the beam optic axis of the modulated beam of said request is compounded on the same axle by said beam synthesizing means, and **** of said unnecessary diffraction beam is also coincided mostly. In the invention according to claim 7, the AKURO mart condenser has been arranged behind said afocal optical system in the laser optics device according to claim 5 or 6.
[0014]In the invention according to claim 8, the path of a beam with the longer wavelength among the beams which enter into said afocal optical system is characterized by being larger than the path of a beam with a shorter wavelength in the laser optics device according to claim 6 or 7. In the invention according to claim 9, it is a beam scanning device which has a laser optics device of any one description of the Claims 1-8, and is characterized by the beam scanning device which has back one piece or two beam scanning means which scan the modulated beam of said request from said all optical systems.
[0015]
[Function]According to the invention according to claim 1, the separation angle of two or more diffraction beams is expanded by an optical element with negative power, and only a desired modulated beam is taken out by the shielding member. According to the invention according to claim 2, the separation angle of two or more diffraction beams is expanded by an optical element with positive power, and only a desired modulated beam is taken out by the shielding member. As for the modulated beam of the request which the separation angle of two or more diffraction beams was expanded, and passed the opening of the shielding member by the optical element with positive power, according to the invention according to claim 3, the parallelism of a beam is maintained even after afocal optical system outgoing radiation.
[0016]According to the invention according to claim 4, the distance in the shielding member position of the beam optic axis of a desired modulated beam and the unnecessary beam optic axis of a diffraction beam becomes larger. According to the invention according to claim 5, the difference in **** by the difference in a wavelength does not occur by coinciding the beam optic axis of the modulated beam of several requests from which a wavelength differs. According to the invention according to claim 6, the difference in **** by the difference in a wavelength does not generate an unnecessary diffraction beam, either.
[0017]According to the invention according to claim 7, when it applies to a beam scanning device etc., a desired modulated beam connects a focus to a predetermined image side position. According to the invention according to claim 8, when it applies to a beam scanning device, according to the invention according to claim 9 which connects a focus with the spot size as a predetermined image side position with same modulated beam of a request of a different wavelength, the beam scanning device using said each laser optics device can be provided.
[0018]

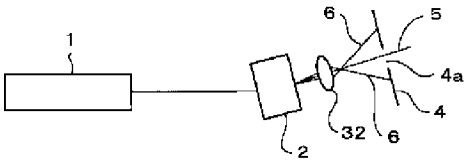
[Embodiment of the Invention]Drawing 1 is a figure explaining a 1st embodiment of this invention. In drawing 1, the collimated beam which was emitted from the laser light source 1 and entered into AOM2 receives abnormal conditions in AOM2, and emits them as two or more diffraction beams, such as a zero order light and primary [**] light. Two or more diffraction beams emitted from AOM2 have a separation angle depending on the wavelength of the beam which entered, and the carrier frequency of the supersonic vibration inputted into AOM. Although the separation angle of the diffraction beam of these plurality is small, in short optical distance, the diffraction beam emitted from the optical element 31 can expand a separation angle according to the refraction effect by placing the optical element 31 which has negative power in immediately after. Since the desired modulated beam 5 passes through a lens center by being in agreement and arranging the desired modulated beam 5 and optic axis which use the optical element 31 henceforth, the beam optic axis goes straight on, without being refracted. However, the modulated beam 5 of the request which entered as a parallel pencil is emitted as emission light flux. In the back of the optical element 31, since beams 6 other than a desired beam, i.e., an unnecessary diffraction beam, are fully separated in distance from the desired modulated beam 5, only the unnecessary diffraction beam 6 can be easily shaded by the shielding member 4 with the opening 4a of a moderate size. It is better to be larger than the path of a desired modulated beam here by the Reason for having already described it as the moderate size of the opening 4a. However, it must carry out to such an extent that an unnecessary diffraction beam does not enter. Even if there is variation with unavoidable part accuracy etc., the power of the optical element 31, the distance from this optical element 31 to the shielding member 4, and the size of the opening 4a are decided so that only a desired modulated beam may be obtained. If only calling it an optical element here suits the purpose, a compound lens with two or more lenses may be sufficient even as a single lens. What is necessary is in short, just to be able to deal with it as one lens optically. Also in the following explanation, it is the same.
[0019]Drawing 2 is a figure explaining a 2nd embodiment of this invention. The difference from drawing 1 is the point that the optical element just behind AOM is the optical element 32 with positive power. In drawing 2, the unnecessary beam optic axis of a diffraction beam has a separation angle between desired modulated beams, and although it seems to be divergence apparently, each beam is a parallel pencil. Therefore, each beam refracted by the optical element connects a focus to a position conflicting mutually on the focal plane of an optical element. However, from the focal position of an optical element, it converges behind a little and the beam optic axis of each beam is emitted after that. Although the separation angle of each beam before entering into the optical element 32 is small, in short optical distance, the separation angle of a diffraction beam is expandable by enlarging lens power of the optical element 32. By coinciding the optic axis of the optical element 32 with the beam optic axis of the modulated beam 5 of the actually used request, the beam optic axis of the desired modulated beam 5 does not receive a refraction operation, but goes straight on. However, it will become emission light flux and the modulated beam 5 of the request which entered into the optical element 32 as a parallel pencil will advance, if the focal position of the optical element 32 is passed. Although the unnecessary diffraction beam 6 also connects a focus on the focal plane of the optical element 32 as mentioned above, the beam optic axis crosses the beam optic axis of a desired modulated beam behind rather than said focal position. In the back

of the intersection of both the beam optic axis, since the beam optic axis of the unnecessary diffraction beam 6 is separated in [as the beam optic axis of the desired modulated beam 5] distance, only a desired modulated beam can be taken out by choosing the position of the shielding member 4 like Embodiment 1. If the position of the shielding member 4 is established in a near position from the intersection of said both beam optic axis, the distance between said both beam optic axes may become small rather than the distance between both beam optic axes when entering into the optical element 3. In order to prevent this problem arising, only the distance same at least as the distance from the optical element 32 to said intersection position is preferred, and the position which the shielding member 4 places needs to be more distant from said intersection.

Drawing 1:



Drawing 2:



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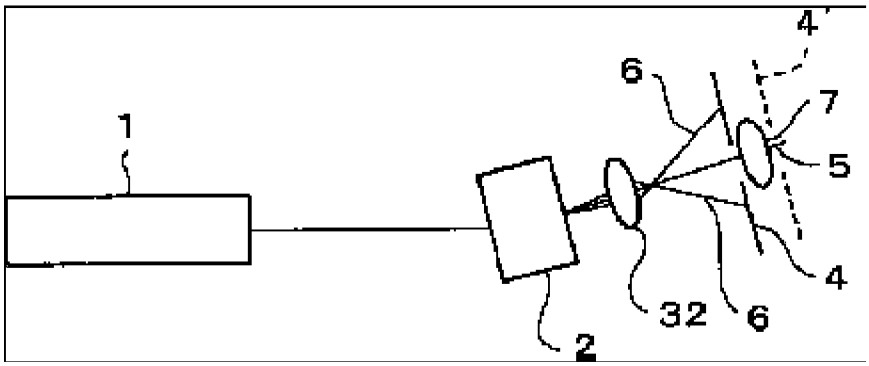

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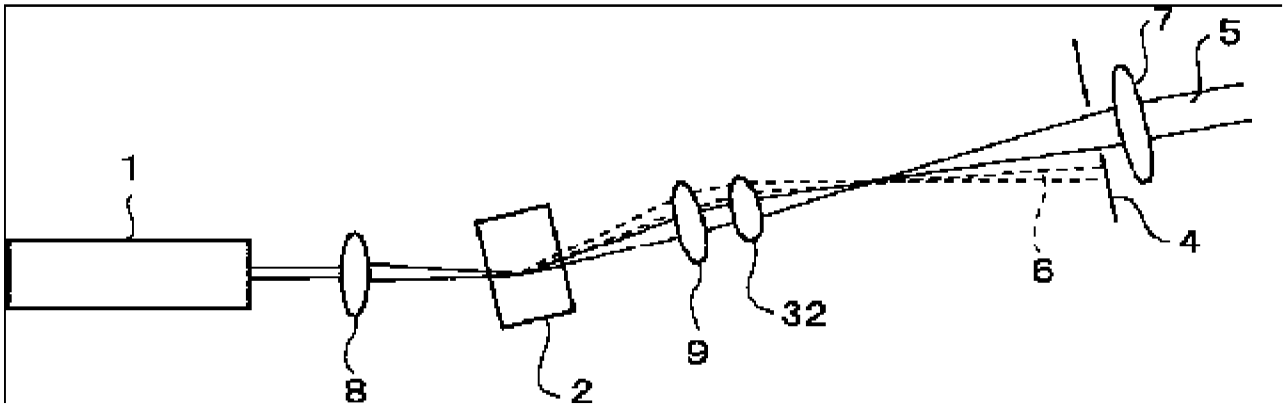

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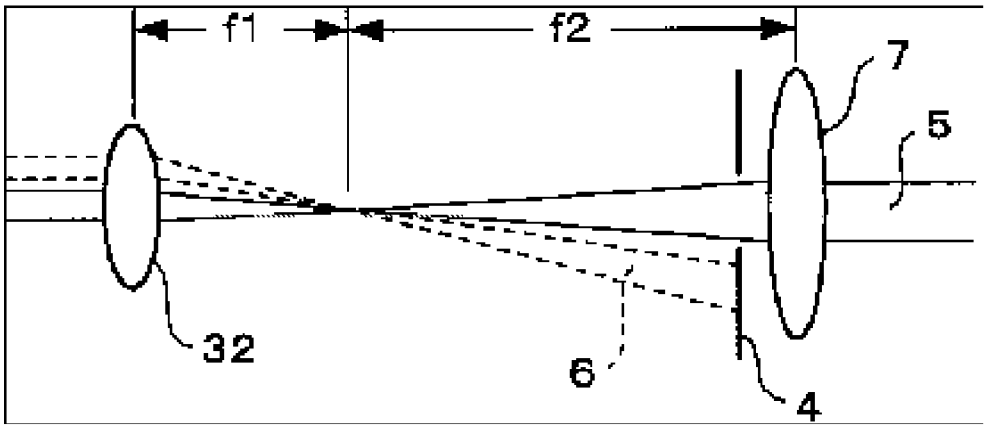

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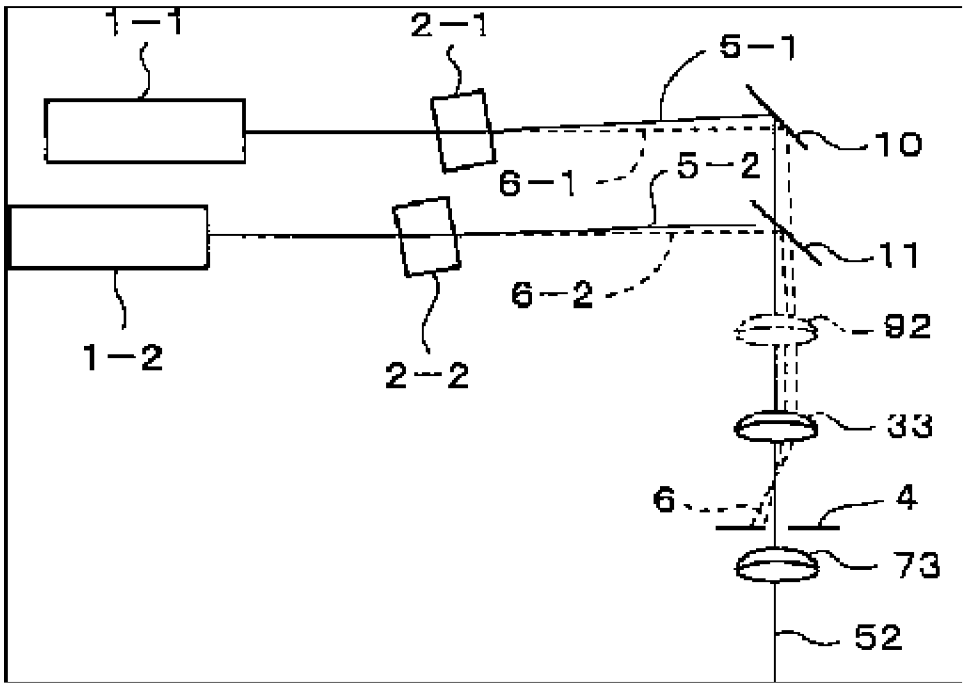
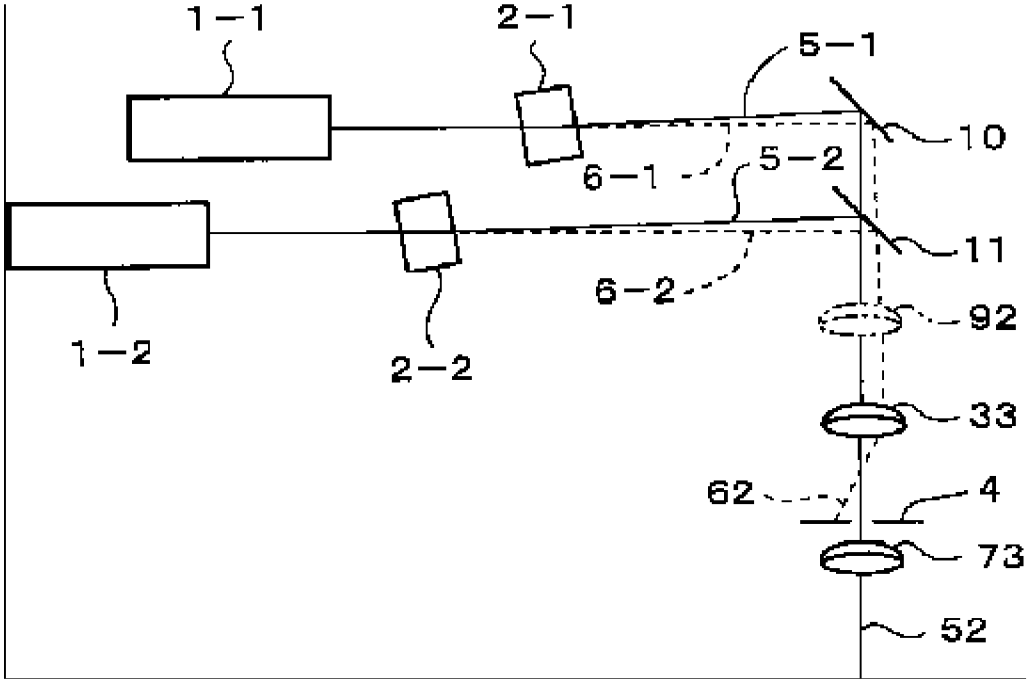
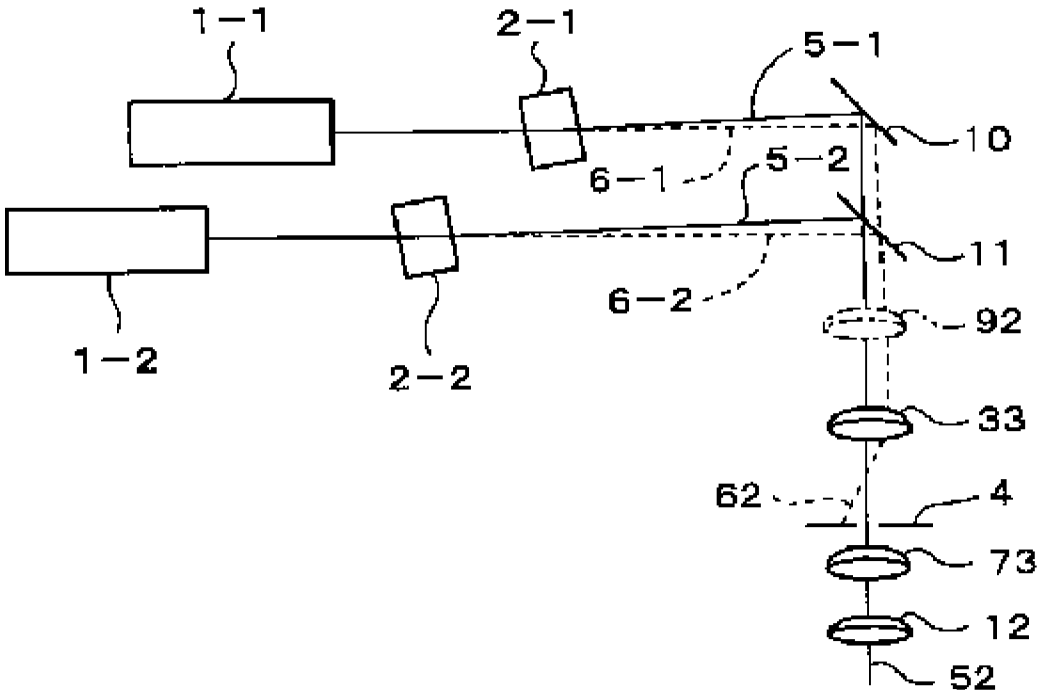


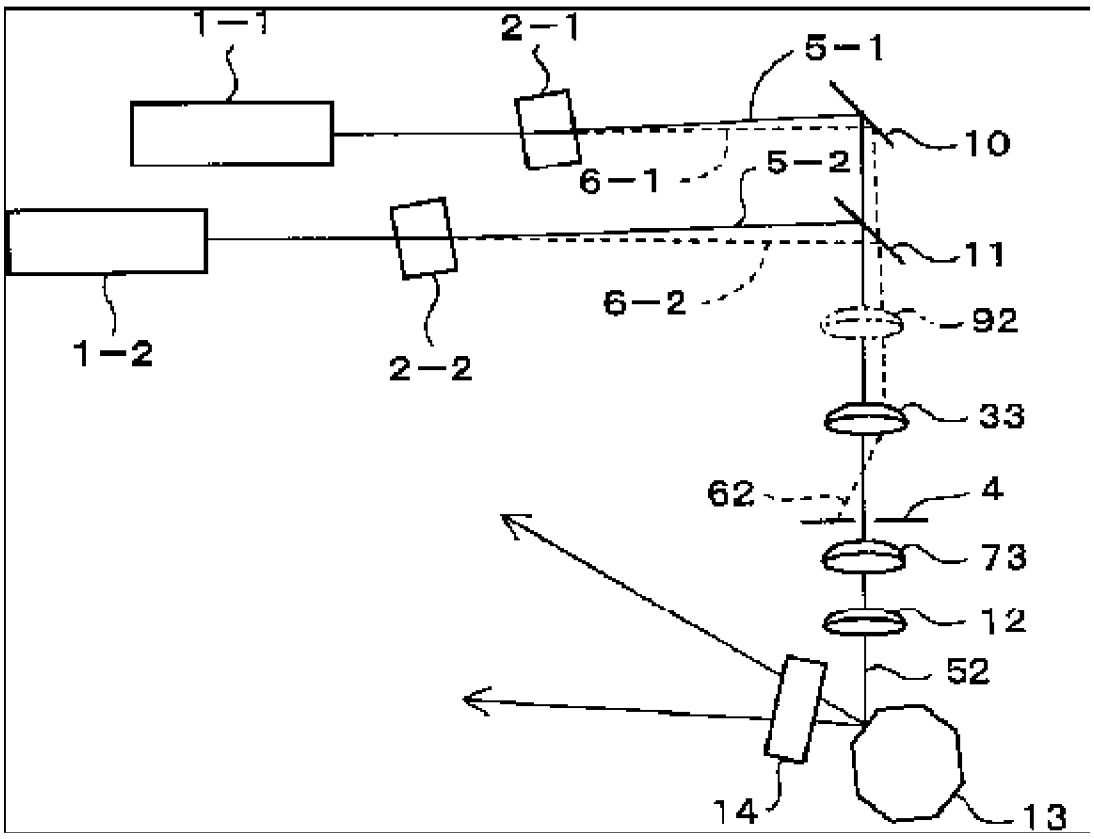
Drawing 7:



Drawing 8:



Drawing 9:



Drawing 10: